INDUCED POLARIZATION, RESISTIVITY,

AND MAGNETIC SURVEY

BROMIDE PROJECT

RIO ARRIBA COUNTY, NEW MEXICO

FOR

U.S. BORAX AND CHEMICAL CORPORATION

PROJECT 0640

mining geophysical surveys

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DISTRIBUTION:

ORIGINAL & 2 COPIES: Barry French, Tucson

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SUMMARY:

Possible anomalous IP response occurs off the southwest end of Lines 1 and 2. However, according to Barry French, geologist for U.S. Borax, this area is not geologically favorable for massive sulfide mineralization.

Only background IP response was observed over the remainder of the survey area. Either the total sulfide mineralization is too small to cause an anomalous IP response or small sulfide bodies are buried too deeply to cause a measurable IP response.

A narrow zone of low conductivity was found along strike from a shaft located northeast of the Payroll Mine, but no anomalous IP response is associated with the zone.

A magnetic survey located a zone of variable high magnetic intensity that is adjacent to a zone of relatively low magnetic intensity. The high magnetic intensities occur over meta-andesites. Line to line correlation between individual zones of high magnetic intensity is difficult because of the large spacing between lines.

INTRODUCTION:

An induced polarization, resistivity, and magnetic survey was carried out in the titled area during the period September 22, 1976 to October 5, 1976. The survey was under the direction of Thomas Yanick, technician and Robert E. West, geophysicist for Mining Geophysical Surveys. The interpretation and report are by Robert E. West and W. Gordon Wieduwilt, geophysicists for Mining Geophysical Surveys.

Rocks in the area include Pre-Cambrian meta-andesites, metarhyolites, and granodiorites. Six magnetic and IP lines were run perpendicular to the strike of a suspected massive sulfide zone.

SURVEY PROCEDURE:

The induced polarization and resistivity measurements are made in the time-domain mode of operation using a DCS model IPR-2 receiver, and EGC model 45A transmitter and power supply with a capability of transmitting a maximum of 10 amps of current to the ground. A conventional system of measurements which uses a time cycle of 2.0 seconds "on" and 2.0 seconds "off" – 2.0 seconds "on" and 2.0 seconds "off" (current reversed) was employed.

The commencement of the measurement of the secondary voltage is delayed by 0.45 seconds to avoid coupling and

other transient effects. The integration is performed during the period from 0.45 to 1.10 seconds after the cessation of current.

To conform to a standard presentation, the integral time constant is adjusted to give induced polarization readings equivalent to those obtained with transmitter cycles of 3.0 seconds "on" and 3.0 seconds "off", with integration of the secondary voltage during the first second of the "off" period.

A conventional inline dipole-dipole array was used for Lines 1, 2, 6 and 7. A dipole length "a" equal to 500' was used on Lines 1 and 2. Measurements were made for dipole separation factor "n" of ½, 1, 1½, 2, ..., 5½, 6. Nine current electrodes were used providing a line coverage of approximately 11 times the dipole length. Lines 6 and 7 had a dipole length "a" equal to 200'. Measurements were made for "n"s of one through 6. Line 6 had 9 current electrodes and Line 7 used seven current electrodes for line coverages of 1800' and 2200', respectively.

A modified pole-dipole array was used on Lines 4 and 5 with an "a" spacing of 200'. Measurements were made for "n"s of one through 6. Seven current electrodes were used for Line 4 and 6 current electrodes were used on Line 5. Line coverage is 2000' for Line 4 and 1800' for Line 5. The

reference electrode is in a mine shaft 200' southeast of Line 4 and 400' southeast of Line 5.

Apparent polarization values are the average of a number of IP measurements. If a considerable amount of noise occurs, a histogram of the measurements is plotted. The histogram is used by the receiver operator to determine when a sufficient number of IP measurements has been taken.

Some noise occurred for the larger "n" values but satisfactory histograms were obtained for these measurements. Erratic, extreme noise was observed on Lines 4 and 5 in the conductive zone.

Apparent polarization response is in units of millivolt-seconds-per-volt, or milliseconds (ms), and apparent resistivity is in units of ohmmeters. The data from each line is plotted in quasi-section to facilitate presentation of data at all spacings used.

The magnetic survey was carried out with a McPhar M700 fluxgate magnetometer which measures the vertical component of the magnetic field. The accuracy of the magnetometer is ±5 gammas on the most sensitive scale range (1000 gammas full scale).

Six magnetic lines were observed as specified by Barry French, using a station spacing of 100'. Two base stations were used during the survey to check magnetic field varia-

tions with time. Base Number 1 was used for Line 1. Base Number 2 was used for the rest of the lines. All of the magnetic intensities shown on the profiles use Base Number 2 as a datum. The vertical magnetic intensity at Base Number 1 is 1550 gammas greater than the intensity at Base Number 2. The maximum time between base station readings was approximately four hours. The maximum difference between base station readings was 190 gammas but the majority of the base station readings differed by less than 50 gammas. No correction was made for magnetic field variations with time.

INTERPRETATION:

IP and Resistivity Survey:

Lines 1 and 2 provide coverage over the broad zone of metavolcanic rocks. Since sulfide mineralization is expected to occur in narrow and possibly deep zones, an "a" spacing of 500' was used. Additional detail was provided by reading "n"s of ½ .

Background IP response of 4 to 11 ms occurs on both lines 1 and 2. Several 10 ms closures occur at C_5 but they are likely generated by noise. They do not form any consistent pattern that indicates a valid anomalous IP response.

A valid increase in the apparent IP response does occur on the southwest ends of Lines 1 and 2. A contact with higher response to the southwest is suggested on the Plan Map, but more coverage to the southwest would be necessary to determine if the increase is caused by anomalous response or a change in background. According to Barry French, this response is beyond the area of geologic interest.

Several resistivity contacts can be correlated between Lines 1 and 2 and they are shown on the Plan Map. A 400 to 800 ohmmeter surface layer that is 250' to 500' thick and overlies 2000 ohmmeter rock is centered at electrode C_3 on both Lines 1 and 2.

Background IP response of 3 to 8 ms occurs on both Lines 6 and 7. An "a" spacing of 200' was used on these lines and should easily detect a 70' wide sulfide zone that is buried 200'.

A modified pole-dipole array was used for Lines 4 and 5. The reference electrode was placed in water in a mine shaft 200' southeast of Line 4 and 400' southeast of Line 5. The purpose of these lines was to trace any possible sulfide mineralization in the shaft along strike by electrically connecting the reference electrode to the mineralization. Since the reference electrode is only 1 "a" spacing from Line 4, and 2 "a" spacings from Line 5, the geometric factors

for the pole-dipole array cannot be used to calculate apparent resistivities and the primary voltage-current ratio is shown on the profiles. A definite low occurs in the primary voltage-current ratios off electrode C_3 on Line 4 and electrodes C_2 and C_3 on Lines 5. These are shown by the hachured lows on the profiles. These lows do not represent contours, however. The implication of the lows is that a linear conductive zone extends along strike from the shaft. Erratic, highly noisy IP readings also occur along this zone, but we do not place any significance in these values. They are simply an effect of the very low signal to noise ratio caused by the conductivity of the zone.

Magnetic Survey:

The meta-andesites are magnetite rich compared to the surrounding rock types according to Barry French. This characteristic is shown by the magnetic profiles where high amplitude variations in magnetic intensity of hundreds to thousands of gammas occur over hundreds of feet in the meta-andesites. These variations are caused by near surface sources. The large intensity variations disappear over the adjacent rocks. Magnetic contacts between the high and low susceptibility rocks are shown on the Plan Map.

Attempts were made to correlate individual zones of high magnetic intensity, but the line spacing is too great to do this with any degree of confidence.

Respectfully submitted,

Robert E. West

Robert E. West
Geophysicist

November 9, 1976
Tucson, Arizona

W. Gordon Wieduwilt
Geophysicist

Registered Professional Engineer (Geophysical)
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December 16, 1976

U. S. BORAX
1802 W. Grant Road, Suite 108
Tucson, Arizona 85705

ATTN: Barry French

Dear Barry: RE: Bromide Project
Review of Ground Magnetic Survey

We have made a contour presentation of the titled data. With only minor reservations about subtle trends, there appear to be distinct trends of magnetic highs and lows striking E-W, roughly parallel to the grain of the rocks. Imposed on this major strike is a NE'ly striking cross trend expressing faulting or folding.

There are magnetic variations within all levels of amplitude that likely reflect small (local) magnetic foci in the near-surface rocks. Within the high magnetic trend of greater than 1000 gammas there is a consistent low in the center of each anomaly that suggests continuity line to line. We believe this reflects a bedding or banding characteristic.

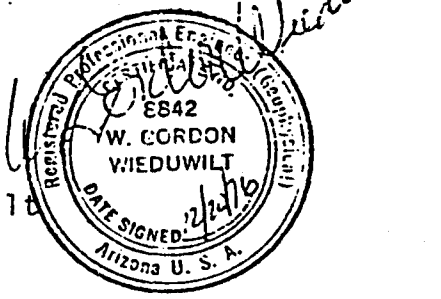
Additional coverage to the north on Lines 10 and 3 would show the termination or extent of the mag high and the mag low in that area. The relationship of highs and lows is important in defining a causative body.

In summary, the present coverage suggests a linear (dike-like) magnetic feature (high) with folding, striking E-W. The trend may terminate to the east near Line 3, but is open to the west. The magnetic characteristics are all believed to reflect

the variation of magnetite in the near-surface rocks, and that the contacts as shown in our earlier report (dated November 9, 1976) remain valid.

You are to be commended for tenaciously sticking to your desire to see a contour map of the data. I think we were a bit too hasty in our assessment of what could be done in the way of a magnetic presentation.

Sincerely,



W. Gordon Wieduwilt

WGW/nw

Enclosure:

1 Magnetic Contour Map